

SELLING-MODE CHOICE IN LIVE-STREAMING E-COMMERCE UNDER PLATFORM TRAFFIC PRICING AND HETEROGENEOUS CONSUMER PREFERENCES

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The rapid growth of live-streaming e-commerce has raised important questions regarding how suppliers should select selling modes when collaborating with live-streaming enterprises (LSEs) in the presence of heterogeneous consumer preferences and platform traffic pricing. We develop a game-theoretic model to examine the strategic interactions among a platform, a supplier, an LSE, and two types of consumers: shopping-preferred (SP) consumers and content-preferred (CP) consumers. The model examines how LSE selling ability, consumer preferences, and platform traffic pricing jointly affect selling-mode choices, traffic decisions, profitability, and the strategic alignment of preferences between the supplier and the LSE. Three main findings emerge. First, selling-mode preferences depend primarily on commission incentives and consumer preferences. Agency selling can align the supplier's and the LSE's preferences when revenue sharing provides sufficient traffic acquisition incentives without imposing excessive commission costs; otherwise, reselling may be mutually preferred. Second, both the supplier and the LSE prefer targeting CP consumers under either selling mode because livestream content creates additional consumer value and increases the sales return generated by acquired traffic. Third, the platform's equilibrium traffic price is determined by its marginal traffic-service cost, whereas the equilibrium amount of traffic acquired varies with the commission rate, LSE selling ability, and consumer preferences. An extension incorporating consumer viewing costs shifts the relevant selling-mode preference boundaries but does not overturn the main qualitative findings. These results provide managerial guidance for selling-mode selection, consumer targeting, and platform traffic pricing in live-streaming e-commerce.

Keywords: Supply Chain Management; Live-Streaming E-Commerce; Selling Mode; Consumer Preference; Game Theory.

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1. INTRODUCTION

With the development of Internet technology, especially the maturity of mobile networks and payment technology, live-streaming shopping has provided a new shopping experience. Consumers can learn about products in real time, interact with streamers, and enjoy discounts through live-streaming, satisfying their need for instant gratification and social interaction. In 2023, Taobao Live had 25,000 brand-operated live-streaming rooms, recording a transaction volume of over 10 million in 334 categories and achieving a growth rate exceeding 100%. In 2023, TikTok saw the coverage of brands' self-operated live-streaming activities reach 51%, with transaction volume from these live streams increasing by 345%. Live-streaming e-commerce has become a major sales channel in China's e-commerce sector, valued at US\$695 billion in 2023 and expected to surpass US\$1 trillion by 2026.

Consumers participating in live-streaming shopping exhibit heterogeneous preferences that significantly influence their purchasing behaviors. Some consumers primarily seek efficient product information acquisition, interactive communication, and purchase convenience, while others are attracted by entertainment, storytelling, and content engagement. Consumers who prefer live-streaming shopping typically value convenience, interaction, and value for money (Chen *et al.*, 2025; Pu *et al.*, 2025). The shopping-preferred (SP) consumers are more likely to make immediate purchasing decisions through product demonstrations, limited-time promotions, and real-time Q&A interactions. For example, well-known brands such as L'Oreal Paris, Guerlain, and Estée Lauder collaborate with top streamer Li Jiaqi to enhance sales performance through interactive product demonstrations. Meanwhile, consumers who prefer live-streaming content tend to focus more on entertainment, education, and information acquisition (Gu *et al.*, 2025; Dong *et al.*, 2025). These content-preferred (CP) consumers obtain value not only from products but also from the content experience generated by live streams. The diversification of live-streaming content, including gaming, educational lectures, and

lifestyle sharing, satisfies consumers' needs for entertainment and knowledge. For example, in the "East Buy" live-streaming room, Dong Yuhui initially attracted viewers through real-time English teaching and interactive communication, and further enhanced consumer engagement by integrating product demonstrations with cultural storytelling.

To serve heterogeneous consumers, suppliers increasingly rely on live-streaming enterprises (LSEs) and must decide how to organize selling relationships with them. Two dominant selling modes have emerged: reselling and agency modes (Hao and Yang, 2023; Xiang *et al.*, 2025). In the reselling mode, LSEs purchase products from suppliers at wholesale prices and resell them to consumers, gaining greater control over retail pricing and sales operations. In contrast, under the agency mode, suppliers retain product ownership and pricing rights, while LSEs promote products and receive commissions based on sales revenue.

Beyond the choice between reselling and agency modes, platforms increasingly influence live-streaming supply chains through paid traffic-allocation mechanisms. Major platforms monetize consumer attention by providing sponsored exposure, algorithmic promotion, and livestream-boosting services. For example, Taobao's Alimama marketing system provides paid-promotion products such as Wanxiangtai and Super Live. At the same time, TikTok's Promote and LIVE Shopping Ads allow sellers and creators to promote videos, LIVEs, and products by selecting campaign objectives, target audiences, budgets, and campaign durations. These services can increase livestream views, product exposure, website visits, and product purchases. Thus, traffic is not only an organic audience flow but also a platform-allocated promotional resource that sellers and LSEs can purchase. By setting the price for these promotional services, the platform balances revenue from traffic monetization against sellers' and LSEs' willingness to purchase additional exposure, making traffic pricing an important strategic decision.

Although recent studies have examined consumer preferences, streamer characteristics, platform traffic decisions, and selling modes in live-streaming e-commerce, these mechanisms have largely been analyzed separately. Limited attention has been paid to how SP/CP consumer heterogeneity and LSE selling ability jointly affect endogenous traffic acquisition under platform traffic pricing and, consequently, the supplier–LSE choice between agency and reselling modes. Moreover, it remains unclear when the supplier and the LSE achieve aligned selling-mode preferences under these interacting mechanisms.

These observations motivate the following research questions:

RQ1. How do heterogeneous consumer preferences shape the supplier's selling-mode choice between agency and reselling modes?

RQ2. How does the LSE's selling ability affect pricing decisions, traffic acquisition, and supply chain profitability under different selling modes?

RQ3. Under what conditions can the supplier and the LSE achieve aligned selling-mode preferences, and how does platform traffic pricing affect traffic acquisition and profitability?

In addition to these core questions, we consider consumer viewing costs as a secondary extension. Specifically, we examine whether the baseline selling-mode and preference-alignment results remain robust when consumers incur a cost of participating in live-streaming shopping.

To address these questions, we develop a live-streaming e-commerce supply chain model consisting of a platform, a supplier, an LSE, and two consumer segments: SP and CP consumers. The platform determines the unit traffic price, the supplier selects the selling mode and makes the corresponding pricing decision, and the LSE determines traffic acquisition and, under the reselling mode, the retail price. We compare the equilibrium outcomes and the supplier's and the LSE's selling-mode preferences under different consumer-preference environments. As a robustness extension, we subsequently incorporate consumer viewing costs to examine whether the main qualitative findings remain valid under a more realistic consumer-participation setting.

Our research yields several interesting findings. First, we show that heterogeneous consumer preferences significantly influence selling-mode choices. The optimal choice between reselling and agency modes depends on the balance between revenue-sharing incentives and strategic alignment incentives. Second, we find that LSE selling ability is an important value-creation mechanism in live-streaming e-commerce. Higher selling ability improves consumer perceived value, enhances purchase responses, and increases the effectiveness of traffic investment. Third, we demonstrate that platform traffic pricing plays an important role in shaping LSE traffic acquisition incentives and the alignment of selling-mode preferences between suppliers and LSEs. Appropriate traffic pricing can encourage LSE participation, whereas excessive traffic costs may weaken traffic investment incentives. Finally, the extension analysis shows that incorporating consumer viewing costs changes equilibrium outcomes quantitatively but does not overturn the main qualitative conclusions, confirming the robustness of our findings.

The main contributions of this study are as follows. First, we integrate heterogeneous consumer preferences, platform traffic pricing, LSE selling ability, and selling-mode choice into a unified analytical framework for live-streaming e-commerce supply chains. Second, we reveal how SP/CP consumer heterogeneity affects channel decisions and consumer-targeting strategies, providing threshold-based insights for suppliers and LSEs. Third, we highlight the strategic role of platform traffic pricing in influencing traffic investment incentives and supplier–LSE preference alignment, extending existing research on platform-based live-streaming supply chains.

The structure of this paper is as follows: Section 2 reviews related literature. Section 3 introduces the model assumptions and decision framework. Section 4 derives equilibrium results under different scenarios. Section 5 compares equilibrium outcomes and analyses strategic choices. Section 6 presents the extension analysis. Section 7 concludes the paper and discusses managerial implications and future research directions.

2. LITERATURE REVIEW

Our research is closely related to three streams of literature: consumer preferences in live-streaming e-commerce, live-streaming selling strategies, and selling-mode choices between reselling and agency modes.

2.1. Consumer preferences

The existing literature mainly focuses on various behavioral preferences of consumers, such as quality preference (Liu *et al.*, 2025), streamer influence (Niu *et al.*, 2025), discount preference (Hardesty *et al.*, 2025), channel preference (Pi *et al.*, 2025), and live-streaming interactivity (Wu *et al.*, 2024). Notably, Gu *et al.* (2025) demonstrate how streamers leverage entertainment bandwidth to influence pricing strategies, consumer engagement, and purchasing behaviors. Wang *et al.* (2023) consider consumers' green preferences and study three recycling models with competitive recycling pricing.

However, most existing studies investigate consumer preferences from specific behavioral dimensions, such as price sensitivity, quality perception, or interaction motivation. Limited attention has been paid to consumer preference heterogeneity in live-streaming e-commerce and its implications for supply chain decisions involving suppliers, LSEs, and platforms. In particular, the distinction between shopping-preferred (SP) consumers, who mainly value product information and purchase convenience, and content-preferred (CP) consumers, who obtain additional value from entertainment and content experiences, remains underexplored.

This study extends the literature by examining how heterogeneous consumer preferences influence supplier–LSE strategic decisions, including selling-mode choices between agency and reselling modes and consumer-targeting strategies.

2.2. Live-streaming selling

While prior work emphasizes the entertainment aspects of live streaming, such as interactivity and social features (Wu *et al.*, 2024; Wang *et al.*, 2023; Li *et al.*, 2025c), other studies investigate consumption motivations, specifically the role of utilitarian and hedonic values in driving purchase decisions (Pu *et al.*, 2025; Pan *et al.*, 2022). Some literature explores whether and when live-streaming should be introduced (Xiang *et al.*, 2025; Huang *et al.*, 2024), pricing strategies (Hao and Yang, 2023; Wang *et al.*, 2025b), product returns (Hao and Yang, 2023; Duan and Song, 2024; Liu *et al.*, 2026a), encroachment (Xie *et al.*, 2025; Xu *et al.*, 2026a), and technology applications (Niu *et al.*, 2026; Zhou *et al.*, 2025). Xu *et al.* (2026b) studied virtual role adoption strategies and the selection of live-streaming media under live-streaming comments. Ye *et al.* (2026) investigate how logistics, time, and initiators affect agricultural product live-streaming strategies. Li *et al.* (2025b) find that intentionally restricting product availability during live streaming can improve retailer profitability. Wang (2025) explores how streamer selling ability and dynamic commissions influence manufacturer profitability and channel choices.

Despite these advances, existing studies mainly focus on operational decisions within live-streaming channels, while the strategic role of platform traffic pricing in influencing LSE traffic acquisition incentives remains insufficiently explored. In practice, platforms generate revenue from traffic services by allocating exposure opportunities and providing paid traffic promotion tools, which directly influence LSEs' incentives to acquire traffic and expand market reach. Therefore, understanding how traffic pricing interacts with consumer heterogeneity and selling-mode decisions is important for live-streaming supply chain management.

Unlike prior studies, this paper integrates consumer preference heterogeneity, LSE selling ability, and platform traffic pricing into a unified framework to examine how these factors jointly influence selling-mode choices, consumer-targeting strategies, and supply chain profitability.

2.3. Reselling and agency

With the rapid growth of e-commerce platforms, many scholars have examined selling modes from various perspectives, including consumer returns (Hao and Yang, 2023), product quality (Liu *et al.*, 2025), price discount strategy (Ji *et al.*, 2023), logistics service (Li *et al.*, 2025a), and brand spillovers (Liu *et al.*, 2026b; Huang *et al.*, 2025). Numerous studies have further analyzed platform choice between reselling and agency modes (Bian *et al.*, 2024; Miao *et al.*, 2025). For example, Abhishek *et al.* (2016) find that platform agency selling can reduce retail prices and improve efficiency under certain conditions. Pei and Li (2023) show that equilibrium prices and service levels differ between reselling and agency

modes under information asymmetry. Some studies have focused on manufacturers' and suppliers' choice of selling modes (Liu *et al.*, 2026a; Wang *et al.*, 2025a).

However, most existing studies focus on traditional e-commerce platform channel structures or manufacturer–platform selling relationships. Less attention has been devoted to supplier–LSE selling-mode choices in live-streaming e-commerce, where LSEs simultaneously influence consumer engagement, traffic acquisition, and product sales.

This study differs from prior literature by investigating how suppliers select between agency and reselling modes when collaborating with LSEs targeting heterogeneous consumer segments. Moreover, we incorporate platform traffic pricing and LSE selling ability to explain how traffic allocation mechanisms influence selling-mode preferences and preference alignment between suppliers and LSEs.

Overall, the contribution of this study does not arise from introducing consumer preferences, LSE selling ability, traffic pricing, or selling modes individually. Rather, it lies in integrating these mechanisms into a unified analytical framework. This integration enables us to identify how SP/CP consumer heterogeneity changes the returns to traffic acquisition, how LSE selling ability reshapes the agency-versus-reselling thresholds, and when the supplier and the LSE exhibit aligned or conflicting selling-mode preferences. Table 1 summarizes these distinctions from the most closely related literature.

Table 1. The distinctions that set our research apart from the prevailing literature.

Authors	Live-streaming selling	Consumer preference heterogeneity	LSE/Streamer selling ability	Platform traffic pricing	Reselling vs. agency mode
Hao and Yang (2023)	✓				✓
Pan <i>et al.</i> (2022)	✓	✓	✓		
Wang <i>et al.</i> (2023)		✓			
Liu <i>et al.</i> (2025)	✓	✓			
Li <i>et al.</i> (2025c)	✓	✓			
Huang <i>et al.</i> (2024)	✓				
Gu <i>et al.</i> (2025)	✓	✓	✓		
Xu <i>et al.</i> (2026b)	✓		✓		
This study	✓	✓	✓	✓	✓

3. BASIC MODEL AND ASSUMPTIONS

This section proceeds as follows. We first introduce the supply chain members, selling modes, and sequence of decisions. We then derive the conditional purchase proportions of SP and CP consumers from their utility-maximization decisions. Next, we explain how traffic acquisition generates effective consumer reach and combine the reach function with the purchase proportions to obtain final demand. Finally, we present the notation, profit functions, and feasibility conditions used in the subsequent equilibrium analysis.

Our model consists of a supplier, a platform, a live-streaming enterprise (LSE), and two types of consumers: shopping-preferred (SP) consumers and content-preferred (CP) consumers. We investigate how the platform's traffic pricing decision affects the supplier's choice between the agency mode (A) and the reselling mode (R), as well as its choice of collaborating with an LSE targeting SP or CP consumers. The platform sells traffic to the LSE at a unit traffic price p_t , while the LSE purchases traffic to attract consumer attention and generate product sales. Traffic demand t is treated as an endogenous decision variable of the LSE.

Before operational decisions are made, the supplier selects the selling mode, $i \in \{A, R\}$, and the type of LSE with which it collaborates, $j \in \{S, C\}$. Under the agency mode, the supplier retains product ownership and retail pricing rights, while the LSE sells products on behalf of the supplier and receives a predetermined share β of sales revenue. No wholesale transaction occurs between the supplier and the LSE. Under the reselling mode, the LSE purchases products from the supplier at the wholesale price w , obtains product ownership, and determines the retail price. Figure 1 illustrates the two selling modes considered in this study.

The sequence of events is illustrated in Figure 2. Under the agency mode, the platform first determines the unit traffic price p_t . After observing p_t , the supplier determines the retail price p_l . The LSE then observes p_t and p_l and determines its traffic demand t . Finally, consumers make their purchase decisions, and the profits of all supply chain members are realized. Under the reselling mode, the platform first determines the unit traffic price p_t . After observing p_t , the supplier determines the wholesale price w . The LSE then observes p_t and w and jointly determines the retail price p_l and traffic demand t . Finally, consumers make their purchase decisions, and the profits of all supply chain members are realized.

Consumers' baseline product valuations are uniformly dispersed over $[0,1]$, with $\theta \sim U[0,1]$, where θ represents consumers' baseline product valuation (Hotelling, 1929; Huang *et al.*, 2024). The potential consumer segment targeted

by each LSE is normalized to one. Consumers who are not reached by the LSE or do not purchase the product receive an outside-option utility normalized to zero. In addition to baseline product valuation, consumers obtain additional utility from the LSE's interactive live-streaming activities. Such activities can enhance shopping experiences, reduce uncertainty about product quality, and strengthen trust in products and sellers (Niu *et al.*, 2025; Wongkitrungrueng and Assarut, 2020; Liu *et al.*, 2024b). The additional utility generated by live streaming depends on the LSE's selling ability, denoted by δ , and consumers' baseline product valuation θ . An LSE with higher selling ability can generate greater additional value for consumers (Pan *et al.*, 2022). We assume $0 \leq \delta < 1$.

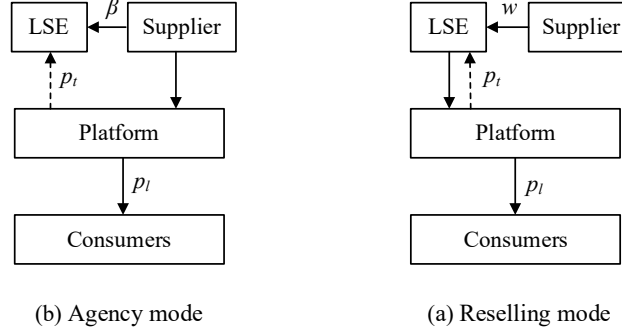


Figure 1. Selling modes.

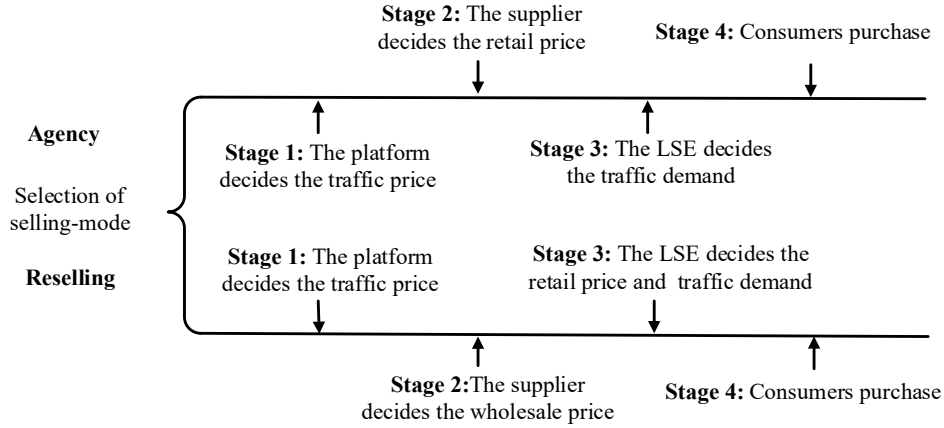


Figure 2. Sequence of events

For SP consumers, the additional utility generated by the LSE's product presentation and selling activities is positively associated with baseline product valuation and is given by $\Delta U^S = \delta\theta$. The utility of an SP consumer who is reached by the LSE and purchases the product is $U^S = (1 + \delta)\theta - p_l$. An SP consumer purchases the product when $U^S \geq 0$. For $0 \leq p_l < 1 + \delta$, the marginal SP consumer is therefore characterized by $\theta = \frac{p_l}{1 + \delta}$. Accordingly, the proportion of SP consumers who purchase the product is $q^S(p_l) = \begin{cases} 1 - \frac{p_l}{1 + \delta}, & 0 \leq p_l < 1 + \delta \\ 0, & p_l \geq 1 + \delta \end{cases}$.

For CP consumers, the additional utility obtained from live-streaming entertainment, interaction, and content is negatively associated with baseline product valuation and is given by $\Delta U^C = \delta(1 - \theta)$. The utility of a CP consumer who is reached by the LSE and purchases the product is $U^C = \theta + (1 - \theta)\delta - p_l$. A CP consumer purchases the product when $U^C \geq 0$. For $\delta < p_l < 1$, the marginal CP consumer is characterized by $\theta = \frac{p_l - \delta}{1 - \delta}$. Therefore, the proportion of

CP consumers who purchase the product is $q^C(p_l) = \begin{cases} 1, & 0 \leq p_l \leq \delta \\ \frac{1 - p_l}{1 - \delta}, & \delta < p_l < 1 \\ 0, & p_l \geq 1 \end{cases}$.

The two purchase proportions reflect different sources of consumer value. SP consumers with higher baseline product valuations obtain greater additional utility from LSE selling activities. By contrast, CP consumers with relatively lower baseline product valuations obtain greater additional utility from the entertainment, interaction, and content experiences provided by live streaming.

The demand system consists of two sequential components: traffic-generated consumer reach and utility-based purchase decisions. The LSE first purchases traffic from the platform to attract consumers to its live-streaming channel.

The consumers reached by the LSE then decide whether to purchase the product according to their utility. Following the attention-based argument of Prat and Valletti (2022), greater traffic acquisition expands the LSE's effective consumer reach, but its marginal effectiveness decreases because of repeated exposure, consumer attention saturation, and declining marginal traffic quality. Accordingly, effective consumer reach is represented by $G(t) = r\sqrt{t}$, where $r > 0$ denotes traffic-reach efficiency and $t \geq 0$. For $t > 0$, $G'(t) = \frac{r}{2\sqrt{t}} > 0$, $G''(t) = -\frac{r}{4t^{3/2}} < 0$. Thus, traffic acquisition increases effective consumer reach but exhibits diminishing marginal returns. Here, $G(t)$ is an effective market-reach measure rather than a normalized probability. Conditional on being reached, consumers purchase with probability $q^j(p_l) \in [0,1]$, and final demand is $D^j = G(t)q^j(p_l)$.

For an LSE targeting SP consumers, final demand is $D^S = \begin{cases} r\sqrt{t}(1 - \frac{p_l}{1+\delta}), & 0 \leq p_l < 1 + \delta, \\ 0, & p_l \geq 1 + \delta. \end{cases}$ For an LSE targeting

CP consumers, final demand is $D^C = \begin{cases} r\sqrt{t}, & 0 \leq p_l \leq \delta, \\ r\sqrt{t}\frac{1-p_l}{1-\delta}, & \delta < p_l < 1, \\ 0, & p_l \geq 1. \end{cases}$ Thus, $G(t)$ determines how many potential consumers

are reached, whereas $q^j(p_l)$ determines the proportion of reached consumers who purchase the product. Accordingly, the model combines a traffic-based reach function with utility-derived purchase proportions rather than introducing a separate inverse-demand system. Any inverse expression used in the equilibrium derivations is merely an algebraic rearrangement of the corresponding utility-derived purchase proportion.

Table 2 summarizes the notation used throughout the paper.

Table 2. Notation and definition used in the model.

Notation	Definition
i	Selling-mode index, where $i \in \{A, R\}$; A and R denote the agency and reselling modes, respectively
j	LSE-type index, where $j \in \{S, C\}$; S and C denote LSEs targeting shopping-preferred and content-preferred consumers, respectively
Parameters	
θ	Consumer's baseline product valuation, where $0 \leq \theta \leq 1$
δ	LSE's selling ability, where $0 \leq \delta < 1$
r	Exogenous traffic-reach efficiency parameter, measuring the effectiveness with which purchased traffic generates additional consumer reach ij
β	Commission rate received by the LSE under the agency mode, where $0 < \beta < \frac{1}{2}$
c_0	Fixed cost incurred by the platform in providing traffic services
c_t	Marginal cost incurred by the platform for providing one unit of traffic
c_l	Consumer viewing cost
Decision variables	
p_l^{ij}	Retail price under scenario ij
p_t^{ij}	Unit traffic price charged by the platform under scenario ij
w^{Rj}	Wholesale price determined by the supplier under reselling scenario Rj
t^{ij}	Endogenous traffic-acquisition decision of the LSE, representing the amount of paid promotional traffic purchased from the platform under scenario ij
Other notations	
D^{ij}	Product demand under scenario ij , where
π_S^{ij}	Supplier's profit under scenario ij , $D^{ij} = G(t^{ij})q^j(p_l^{ij})$
π_{LSE}^{ij}	LSE's profit under scenario ij
π_P^{ij}	Platform's profit under scenario ij

In practice, the unit traffic price p_t corresponds to the price charged by the platform per unit of paid exposure or algorithmic promotion, while traffic demand t can be observed from the number of paid impressions, promoted views, clicks, or unique visitors purchased by the LSE. The traffic-reach efficiency parameter r captures how effectively purchased traffic generates incrementally effective consumer reach and can be estimated using the additional effective views, unique visitors, or product-page visits generated per unit of paid traffic. The LSE selling ability δ represents its capacity to create additional consumer value and convert consumer attention into purchases through product presentation, content design, and real-time interaction. It can be approximated using historical viewer-to-buyer conversion rates, sales per thousand views, or the incremental conversion uplift attributable to the LSE after accounting for product, price, and promotional differences. The commission rate β is directly observable from the revenue-sharing terms specified in the

agency contract. The platform's marginal traffic-service cost c_t can be estimated from the variable costs associated with traffic allocation, recommendation services, computing resources, and promotion operations. These operational indicators provide practical proxies for model calibration and managerial decision-making.

4. MODEL ANALYSIS AND EQUILIBRIUM RESULTS

We examine the supplier's selling-mode choice and consumer preference heterogeneity in live-streaming e-commerce. Combining the two selling modes (agency and reselling) with two consumer preference types (SP and CP), we consider four analytical scenarios: AS, AC, RS, and RC. We derive the equilibrium outcomes for each scenario and subsequently compare the optimal decisions and profit implications across different selling modes and consumer preference types.

4.1. Agency mode

Under the agency mode, the supplier retains product ownership, and the LSE sells products on behalf of the supplier through live streaming. The LSE receives a commission rate β from sales revenue. We consider two scenarios according to consumer preference types.

4.1.1. Scenario with shopping-preferred consumers (Scenario AS)

Under scenario AS, the profits of the supplier, LSE, and platform are respectively given by:

$$\pi_S^{AS} = (1 - \beta)p_l D^{AS}, \quad (1)$$

$$\pi_{LSE}^{AS} = \beta p_l D^{AS} - p_t t, \quad (2)$$

$$\pi_P^{AS} = p_t t - (c_0 + c_t t). \quad (3)$$

Here, $p_t t$ represents the LSE's traffic expenditure paid to the platform, where p_t denotes the unit traffic price and t represents the amount of traffic purchased by the LSE. The term $c_0 + c_t t$ represents the platform's traffic provision cost, where c_0 is the fixed cost of operating the traffic system and c_t is the marginal cost of supplying additional traffic.

Lemma 1. In scenario AS, the equilibrium outcomes are presented as follows: $p_t^{AS*} = 2c_t$, $p_l^{AS*} = \frac{1+\delta}{2}$, and $t^{AS*} = \frac{r^2 \beta^2 (1+\delta)^2}{256c_t^2}$.

Lemma 1 shows that, under the agency mode with an LSE targeting SP consumers, the platform sets the optimal traffic price at twice its marginal traffic cost, balancing traffic revenue and LSE traffic acquisition incentives. The equilibrium retail price $p_l^{AS*} = \frac{1+\delta}{2}$ increases with the LSE's selling ability because a more capable LSE enhances consumers' perceived product value, enabling the supplier to charge a higher price. Moreover, equilibrium traffic demand increases with the traffic-reach efficiency r , the commission rate β , and the LSE's selling ability δ , but decreases with the platform's marginal traffic cost c_t . These results indicate that higher traffic efficiency and stronger LSE selling ability improve the return on traffic investment, whereas higher traffic costs reduce the LSE's incentive to purchase traffic.

4.1.2. Scenario with content-preferred consumers (Scenario AC)

Under scenario AC, the profits of the supplier, LSE, and platform are respectively given by:

$$\pi_S^{AC} = (1 - \beta)p_l D^{AC}, \quad (4)$$

$$\pi_{LSE}^{AC} = \beta p_l D^{AC} - p_t t, \quad (5)$$

$$\pi_P^{AC} = p_t t - (c_0 + c_t t), \quad (6)$$

Lemma 2. In scenario AC, the equilibrium outcomes are presented as follows: (i) If $0 \leq \delta < \frac{1}{2}$, then $p_t^{AC*} = 2c_t$, $p_l^{AC*} = \frac{1}{2}$, and $t^{AC*} = \frac{r^2 \beta^2}{256c_t^2(1-\delta)^2}$. (ii) If $\frac{1}{2} \leq \delta < 1$, then $p_t^{AC*} = 2c_t$, $p_l^{AC*} = \delta$, and $t^{AC*} = \frac{r^2 \beta^2 \delta^2}{16c_t^2}$.

Lemma 2 reveals that the equilibrium under the agency mode with an LSE targeting CP consumers exhibits two regimes depending on the LSE's selling ability. When $0 \leq \delta < \frac{1}{2}$, the retail price remains fixed at $p_l^{AC*} = \frac{1}{2}$, implying that the additional value generated by selling ability mainly stimulates consumer purchase responses and encourages traffic acquisition. When $\frac{1}{2} \leq \delta < 1$, the retail price increases to $p_l^{AC*} = \delta$, suggesting that the supplier captures part of the additional consumer value generated by stronger LSE selling ability. Meanwhile, equilibrium traffic demand increases with the traffic-reach efficiency r , commission rate β , and LSE selling ability, but decreases with the platform's unit traffic cost c_t . Therefore, $\delta = \frac{1}{2}$ represents the critical threshold separating two distinct equilibrium regimes associated with CP consumers' purchase responses.

4.2. Reselling mode

Under the reselling mode, the supplier sells products to the LSE at a wholesale price w , and the LSE resells products to consumers through live streaming at a retail price p_l . The LSE obtains product ownership and is responsible for retail pricing and traffic purchasing decisions. We consider two scenarios according to consumer preference types.

4.2.1. Scenario with shopping-preferred consumers (Scenario RS)

Under scenario RS, the profits of the supplier, LSE, and platform are respectively given by:

$$\pi_S^{RS} = wD^{RS}, \quad (7)$$

$$\pi_{LSE}^{RS} = (p_l - w)D^{RS} - p_t t, \quad (8)$$

$$\pi_P^{RS} = p_t t - (c_0 + c_t t). \quad (9)$$

Lemma 3. In scenario RS, the equilibrium outcomes are presented as follows: $p_t^{RS*} = 2c_t$, $w^{RS*} = \frac{1+\delta}{4}$, $p_l^{RS*} = \frac{5(1+\delta)}{8}$, and $t^{RS*} = \frac{81r^2(1+\delta)^2}{65536c_t^2}$.

Lemma 3 characterizes the equilibrium under the reselling mode with an LSE targeting SP consumers. Similar to the agency mode, the platform sets the optimal traffic price at twice its marginal traffic cost. This result indicates that the platform's cost structure determines the equilibrium traffic price, as the platform balances traffic revenue against traffic provision costs. Both the wholesale price and retail price increase with the LSE's selling ability. This occurs because stronger LSE selling ability enhances consumers' perceived product value, allowing the supplier and the LSE to extract part of the additional value through wholesale and retail pricing decisions. Furthermore, equilibrium traffic demand increases with the traffic-reach efficiency r and the LSE's selling ability δ , because stronger traffic effectiveness and selling capability improve the expected return from traffic investment. Compared with the agency mode, equilibrium traffic demand is lower under reselling. This is because the reselling structure introduces an additional pricing layer between the supplier and the LSE, which weakens the LSE's incentive to invest in traffic acquisition.

4.2.2. Scenario with content-preferred consumers (Scenario RC)

Under scenario RC, the profits of the supplier, LSE, and platform are respectively given by:

$$\pi_S^{RC} = wD^{RC}, \quad (10)$$

$$\pi_{LSE}^{RC} = (p_l - w)D^{RC} - p_t t, \quad (11)$$

$$\pi_P^{RC} = p_t t - (c_0 + c_t t). \quad (12)$$

Lemma 4. In scenario RC, the equilibrium outcomes are presented as follows: (i) If $0 \leq \delta < \frac{5}{8}$, then $p_t^{RC*} = 2c_t$, $w^{RC*} = \frac{1}{4}$, $p_l^{RC*} = \frac{5}{8}$, and $t^{RC*} = \frac{81r^2}{65536c_t^2(1-\delta)^2}$. (ii) If $\frac{5}{8} \leq \delta < \frac{2}{3}$, then $p_t^{RC*} = 2c_t$, $w^{RC*} = 2\delta - 1$, $p_l^{RC*} = \delta$, and $t^{RC*} = \frac{r^2(1-\delta)^2}{16c_t^2}$. (iii) If $\frac{2}{3} \leq \delta < 1$, then $p_t^{RC*} = 2c_t$, $w^{RC*} = \frac{\delta}{2}$, $p_l^{RC*} = \delta$, and $t^{RC*} = \frac{r^2\delta^2}{64c_t^2}$.

Lemma 4 shows that the equilibrium under the reselling mode with an LSE targeting CP consumers exhibits three regimes depending on the LSE's selling ability. When $0 \leq \delta < \frac{5}{8}$, the equilibrium wholesale and retail prices remain unchanged. In this region, improvements in selling ability mainly enhance consumers' perceived value and increase traffic demand rather than affecting pricing decisions. When $\frac{5}{8} \leq \delta < \frac{2}{3}$, the supplier adjusts the wholesale price upward as the LSE's selling ability improves, while the retail price increases to reflect the enhanced consumer value generated by live-streaming content. When $\frac{2}{3} \leq \delta < 1$, the retail price remains at $p_t^{RC*} = \delta$, while further improvements in selling ability are mainly reflected in the wholesale pricing decision; this indicates that when the LSE provides sufficiently strong content value, the supply chain gradually shifts from consumer price adjustment toward profit allocation through wholesale pricing. Overall, stronger LSE selling ability increases traffic demand and reshapes the equilibrium pricing structure under the reselling mode with CP consumers.

Table 1. Equilibrium outcomes under AS and AC scenarios.

Equilibrium outcomes	AS	AC ₁	AC ₂
p_t^{ij*}	$2c_t$	$2c_t$	$2c_t$
w^{Rj*}	—	—	—
p_l^{ij*}	$\frac{1+\delta}{2}$	$\frac{1}{2}$	δ
t^{ij*}	$\frac{r^2\beta^2(1+\delta)^2}{256c_t^2}$	$\frac{r^2\beta^2}{256c_t^2(1-\delta)^2}$	$\frac{r^2\beta^2\delta^2}{16c_t^2}$
D^{ij*}	$\frac{r^2\beta(1+\delta)}{32c_t}$	$\frac{r^2\beta}{32c_t(1-\delta)^2}$	$\frac{r^2\beta\delta}{4c_t}$
π_S^{ij*}	$\frac{r^2\beta(1-\beta)(1+\delta)^2}{64c_t}$	$\frac{r^2\beta(1-\beta)}{64c_t(1-\delta)^2}$	$\frac{r^2\beta(1-\beta)\delta^2}{4c_t}$
π_{LSE}^{ij*}	$\frac{r^2\beta^2(1+\delta)^2}{128c_t}$	$\frac{r^2\beta^2}{128c_t(1-\delta)^2}$	$\frac{r^2\beta^2\delta^2}{8c_t}$
π_P^{ij*}	$\frac{r^2\beta^2(1+\delta)^2}{256c_t} - c_0$	$\frac{r^2\beta^2}{256c_t(1-\delta)^2} - c_0$	$\frac{r^2\beta^2\delta^2}{16c_t} - c_0$

Notes: AC₁ and AC₂ denote the two equilibrium regions separated by the threshold $\delta = \frac{1}{2}$. Specifically, AC₁ applies when $0 \leq \delta < \frac{1}{2}$, whereas AC₂ applies when $\frac{1}{2} \leq \delta < 1$.

Table 4. Equilibrium outcomes under RS and RC scenarios.

Equilibrium outcomes	RS	RC ₁	RC ₂	RC ₃
p_t^{ij*}	$2c_t$	$2c_t$	$2c_t$	$2c_t$
w^{Rj*}	$\frac{1+\delta}{4}$	$\frac{1}{4}$	$2\delta - 1$	$\frac{\delta}{2}$
p_l^{ij*}	$\frac{5(1+\delta)}{8}$	$\frac{5}{8}$	δ	δ
t^{ij*}	$\frac{81r^2(1+\delta)^2}{65536c_t^2}$	$\frac{81r^2}{65536c_t^2(1-\delta)^2}$	$\frac{r^2(1-\delta)^2}{16c_t^2}$	$\frac{r^2\delta^2}{64c_t^2}$
D^{ij*}	$\frac{27r^2(1+\delta)}{2048c_t}$	$\frac{27r^2}{2048c_t(1-\delta)^2}$	$\frac{r^2(1-\delta)}{4c_t}$	$\frac{r^2\delta}{8c_t}$
π_S^{ij*}	$\frac{27r^2(1+\delta)^2}{8192c_t}$	$\frac{27r^2}{8192c_t(1-\delta)^2}$	$\frac{r^2(2\delta-1)(1-\delta)}{4c_t}$	$\frac{r^2\delta^2}{16c_t}$
π_{LSE}^{ij*}	$\frac{81r^2(1+\delta)^2}{32768c_t}$	$\frac{81r^2}{32768c_t(1-\delta)^2}$	$\frac{r^2(1-\delta)^2}{8c_t}$	$\frac{r^2\delta^2}{32c_t}$
π_P^{ij*}	$\frac{81r^2(1+\delta)^2}{65536c_t} - c_0$	$\frac{81r^2}{65536c_t(1-\delta)^2} - c_0$	$\frac{r^2(1-\delta)^2}{16c_t} - c_0$	$\frac{r^2\delta^2}{64c_t} - c_0$

Notes: RC₁, RC₂, and RC₃ denote the three equilibrium regions separated by the thresholds $\delta = \frac{5}{8}$ and $\delta = \frac{2}{3}$. Specifically, RC₁ applies when $0 \leq \delta < \frac{5}{8}$, RC₂ applies when $\frac{5}{8} \leq \delta < \frac{2}{3}$, and RC₃ applies when $\frac{2}{3} \leq \delta < 1$.

5. EQUILIBRIUM RESULTS

In this section, we first compare the equilibrium pricing decisions and traffic demands between the reselling mode and the agency mode. Based on these comparisons, we derive the selling-mode preference conditions and characterize the equilibrium implications, as summarized in Proposition 1. We then compare the equilibrium outcomes between SP and CP consumers and investigate the corresponding consumer-targeting strategies, as summarized in Proposition 2.

5.1. Selling-model choice between reselling and agency modes

We compare the equilibrium pricing decisions and traffic demands between the reselling mode and the agency mode. Based on these comparisons, we derive Corollary 1, which characterizes the differences in equilibrium decisions between the two selling modes.

Corollary 1. Equilibrium comparison between agency and reselling modes. (i) Facing SP consumers, the equilibrium outcomes under the agency mode and the reselling mode satisfy: (a) $p_t^{AS*} = p_t^{RS*}$. (b) $p_l^{AS*} < p_l^{RS*}$. (c) If $\beta > \beta_L^S$, then $t^{AS*} > t^{RS*}$; otherwise, $t^{AS*} \leq t^{RS*}$. (ii) Facing CP consumers, the equilibrium outcomes under the agency mode and the reselling mode satisfy: (a) $p_t^{AC*} = p_t^{RC*}$. (b) If $0 \leq \delta < \frac{5}{8}$, then $p_l^{AC*} < p_l^{RC*}$; if $\frac{5}{8} \leq \delta < 1$, then $p_l^{AC*} = p_l^{RC*}$. (c) If $\beta > \beta_L^C(\delta)$, then $t^{AC*} > t^{RC*}$; otherwise, $t^{AC*} \leq t^{RC*}$.

$$\text{where } \beta_L^S = \frac{9}{16} \text{ and } \beta_L^C(\delta) = \begin{cases} \frac{9}{16}, & 0 \leq \delta < \frac{1}{2}, \\ \frac{9}{64\delta(1-\delta)}, & \frac{1}{2} \leq \delta < \frac{5}{8}, \\ \frac{1-\delta}{8}, & \frac{5}{8} \leq \delta < \frac{2}{3}, \\ \frac{1}{2}, & \frac{2}{3} \leq \delta < 1. \end{cases}$$

Corollary 1 compares the equilibrium outcomes between agency and reselling modes under different consumer preference types. In both SP and CP markets, the platform charges the same optimal traffic price across selling modes because its pricing decision is primarily determined by the marginal cost of traffic provision rather than the downstream selling structure. However, retail prices and traffic demand differ because agency and reselling modes generate different incentive structures. Under the reselling mode, wholesale transactions introduce an additional pricing layer, which increases retail prices and weakens the LSE's incentive to purchase traffic. By contrast, the agency mode allows the supplier and the LSE to share sales revenue, which can stimulate traffic investment when the commission rate is sufficiently high. For CP consumers, the threshold $\beta_L^C(\delta)$ varies with LSE selling ability because stronger selling ability changes consumer purchase responses and equilibrium pricing regimes.

Theorem 1. Selling-mode preferences of the supplier and the LSE under SP consumers. (a) Supplier preference. If $\underline{\beta}_S < \beta < \bar{\beta}_S$, then $\pi_S^{AS*} > \pi_S^{RS*}$; otherwise, $\pi_S^{AS*} \leq \pi_S^{RS*}$. (b) LSE preference. If $\beta > \beta_L^S$, then $\pi_{LSE}^{AS*} > \pi_{LSE}^{RS*}$; otherwise, $\pi_{LSE}^{AS*} \leq \pi_{LSE}^{RS*}$.

$$\text{where } \underline{\beta}_S = \frac{8-\sqrt{10}}{16} \text{ and } \bar{\beta}_S = \frac{8+\sqrt{10}}{16}.$$

The results of Theorem 1 are illustrated in Figure 3. Other parameter values are fixed at $r = 0.2$, $\delta = 0.5$, and $c_t = 0.01$, unless otherwise specified. Theorem 1 shows that the supplier's and the LSE's preferences between agency and reselling modes are mainly determined by the revenue-sharing structure under the SP market. For the supplier, the agency mode is preferred only when the commission rate lies within an intermediate range. A moderate commission rate enables the supplier to benefit from the LSE's traffic investment while avoiding excessive revenue sharing. When the commission rate is too low, the LSE lacks sufficient incentives to invest in traffic; when the commission rate is too high, the supplier bears excessive commission costs. Therefore, the supplier prefers reselling outside the intermediate commission region. In contrast, the LSE prefers the agency mode when the commission rate is sufficiently high because a larger revenue share increases the return from traffic investment. Consequently, the agency mode can achieve preference alignment only within a specific commission-rate range.

Theorem 2. Selling-mode preferences of the supplier and the LSE under CP consumers. (a) Supplier preference. If $\beta_C(\delta) < \beta < \bar{\beta}_C(\delta)$, then $\pi_S^{AC*} > \pi_S^{RC*}$; otherwise, $\pi_S^{AC*} \leq \pi_S^{RC*}$. (b) LSE preference. If $\beta > \beta_L^C(\delta)$, then $\pi_{LSE}^{AC*} > \pi_{LSE}^{RC*}$; otherwise, $\pi_{LSE}^{AC*} \leq \pi_{LSE}^{RC*}$.

$$\text{where } \underline{\beta}_c(\delta) = \begin{cases} \frac{8-\sqrt{10}}{16}, & 0 \leq \delta < \frac{1}{2}, \\ \frac{1}{2} \left[1 - \sqrt{1 - \frac{27}{512\delta^2(1-\delta)^2}} \right], & \frac{1}{2} \leq \delta < \frac{5}{8}, \\ 2 - \frac{1}{\delta}, & \frac{5}{8} \leq \delta < \frac{2}{3}, \\ \frac{1}{2}, & \frac{2}{3} \leq \delta < 1. \end{cases} \text{ and } \bar{\beta}_c(\delta) = \begin{cases} \frac{8+\sqrt{10}}{16}, & 0 \leq \delta < \frac{1}{2}, \\ \frac{1}{2} \left[1 + \sqrt{1 - \frac{27}{512\delta^2(1-\delta)^2}} \right], & \frac{1}{2} \leq \delta < \frac{5}{8}, \\ \frac{1-\delta}{\delta}, & \frac{5}{8} \leq \delta < \frac{2}{3}, \\ \frac{1}{2}, & \frac{2}{3} \leq \delta < 1. \end{cases}$$

The results of Theorem 2 are illustrated in Figure 4. Because all other parameters cancel out from the equilibrium profit comparisons, the preference regions depend only on the LSE's selling ability δ and the commission rate β ; hence, no additional numerical parameter values are required. The shaded areas indicate the parameter regions in which the supplier or the LSE prefers the agency mode over the reselling mode. Theorem 2 demonstrates that, in the CP market, the preference between agency and reselling modes depends jointly on the commission rate and the LSE's selling ability. Unlike the SP market, the supplier's mode-choice thresholds vary with δ , because stronger LSE selling ability increases the content value perceived by consumers and changes purchase responses. Specifically, live-streaming content enhances consumer engagement and generates additional consumption value, thereby increasing the sales return generated by traffic acquisition. This is consistent with Sun *et al.* (2021). Therefore, stronger LSE selling ability reshapes the relative profitability of agency and reselling modes. For the supplier, agency mode is preferred within an intermediate commission-rate region, whereas excessive commission rates make reselling more attractive. These results highlight the important role of LSE selling ability in determining selling mode choices.

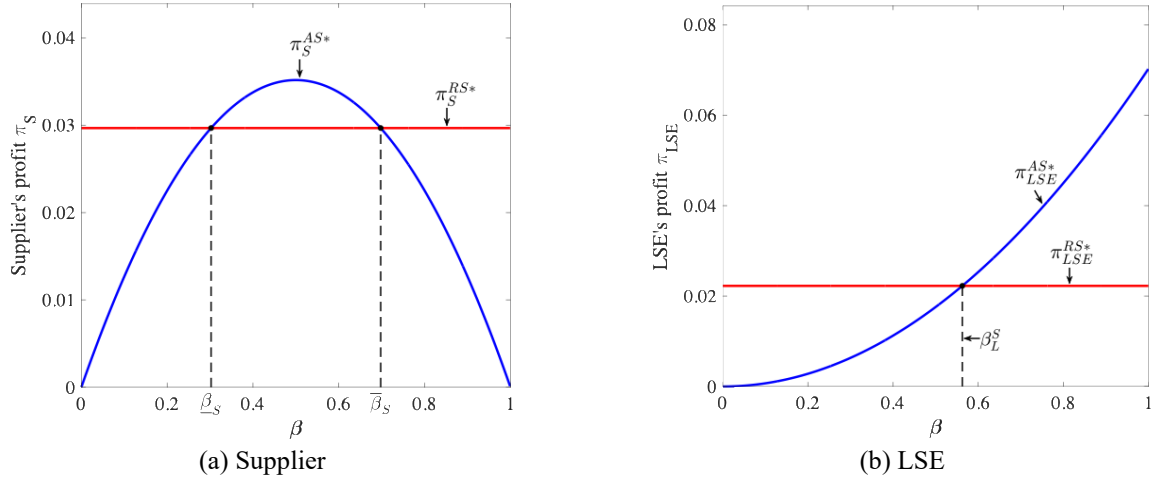


Figure 3. Selling-mode preferences of the supplier and the LSE under SP consumers ($r = 0.2, \delta = 0.5, c_t = 0.01$).

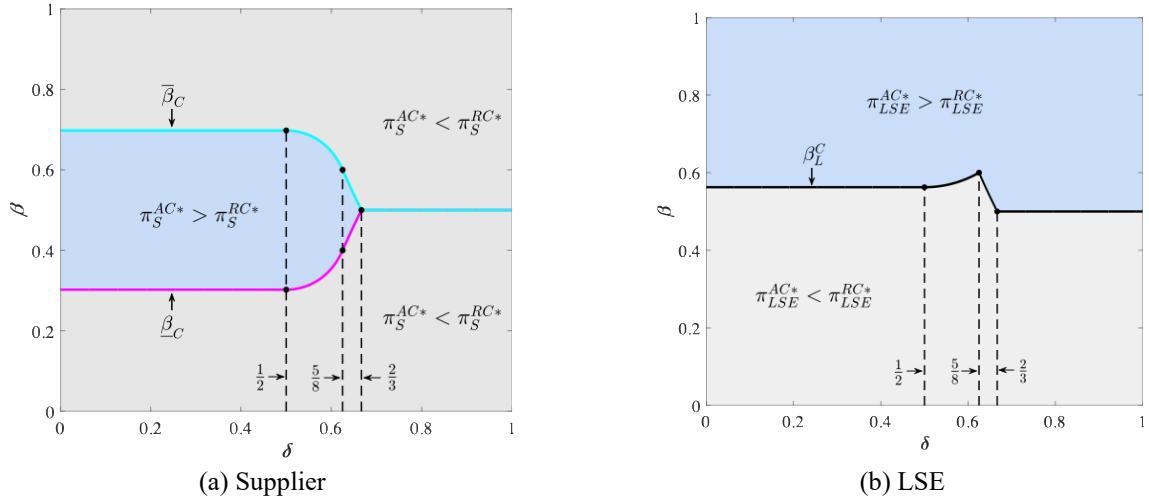


Figure 4. Selling-mode preferences of the supplier and the LSE under CP consumers.

Proposition 1. Selling-mode preference alignment under heterogeneous consumer preferences. (i) For SP consumers, both the supplier and the LSE prefer the reselling mode when $0 < \beta < \underline{\beta}_S$; both parties prefer the agency mode when $\beta_L^S < \beta < \bar{\beta}_S$. (ii) For CP consumers, both the supplier and the LSE prefer the reselling mode when $0 \leq \delta < 1$ and $0 < \beta < \underline{\beta}_C(\delta)$; both parties prefer the agency mode when $0 \leq \delta < \frac{5}{8}$ and $\beta_L^C(\delta) < \beta < \bar{\beta}_C(\delta)$.

The results of Proposition 1 are illustrated in Figure 5. Because all other parameters cancel out from the relevant profit comparisons, the preference-alignment and conflict regions in Figure 5 are also determined solely by δ and β . The boundaries of these regions are determined by $\underline{\beta}_C(\delta)$, $\beta_L^C(\delta)$, and $\bar{\beta}_C(\delta)$, whose definitions and applicable ranges are provided in Theorem 2. Proposition 1 characterizes the conditions under which the supplier and the LSE exhibit aligned selling-mode preferences. Under SP consumers, the preference-alignment regions are mainly determined by the commission rate. When the commission rate is relatively low, both parties prefer the reselling mode because a low commission rate reduces the LSE's return from traffic investment under the agency mode, while the supplier benefits from a stable wholesale margin. When the commission rate becomes moderate, the agency mode becomes mutually preferred because revenue sharing provides stronger incentives for traffic investment and alleviates the inefficiency caused by decentralized pricing decisions.

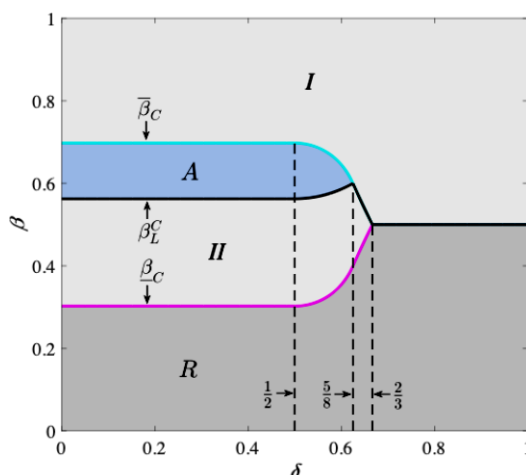


Figure 5. Selling-mode preference alignment and conflict regions under CP consumers.

Under CP consumers, selling-mode preference becomes more complex because LSE selling ability affects consumer purchase responses and traffic value. As shown in Figure 5, regions I and II represent two types of preference conflicts. Region I corresponds to the case where the LSE prefers agency mode while the supplier prefers reselling mode, because the LSE benefits from higher traffic incentives whereas the supplier is more concerned with commission costs. Region II represents the opposite conflict, where the supplier prefers agency mode due to reduced pricing inefficiency, while the LSE prefers reselling because the agency commission is insufficient to compensate for traffic investment. Therefore, selling-mode alignment depends on the balance between incentive provision and profit allocation.

5.2. Equilibrium comparison across consumer-preference types

We compare the equilibrium pricing decisions and traffic demands under SP and CP consumers. The following corollary characterizes how consumer preference heterogeneity affects the optimal operational decisions of supply chain members.

Corollary 2. Equilibrium comparison between SP and CP consumers. (i) Under the agency mode, for all $0 \leq \delta < 1$, $p_t^{AS*} = p_t^{AC*}$, $p_l^{AS*} > p_l^{AC*}$, $t^{AS*} < t^{AC*}$. (ii) Under the reselling mode, for all $0 \leq \delta < 1$, $p_t^{RS*} = p_t^{RC*}$, $w^{RS*} > w^{RC*}$, $p_l^{RS*} > p_l^{RC*}$, $t^{RS*} < t^{RC*}$.

Corollary 2 demonstrates that CP consumers generate a larger traffic expansion effect than SP consumers under both selling modes. The equilibrium traffic price remains unchanged because it is determined by the platform's traffic provision cost rather than consumer preference types. However, consumer heterogeneity significantly affects downstream pricing and traffic acquisition decisions. Specifically, SP consumers obtain additional utility mainly from product-related interactions, and this utility is positively associated with their intrinsic product valuation. Therefore, suppliers can charge a higher retail price but face a relatively limited market expansion effect. In contrast, CP consumers derive greater value from entertainment and content experiences, especially consumers with lower baseline product valuations. This content-

driven utility enables the LSE to attract more marginal consumers and increase traffic demand. Consequently, CP consumers generate higher market coverage at the expense of lower equilibrium prices.

Theorem 3. Profit comparison between SP and CP consumers under different selling modes. (i) Under the agency mode, for all $0 \leq \delta < 1$, $\pi_S^{AC*} > \pi_S^{AS*}$, $\pi_{LSE}^{AC*} > \pi_{LSE}^{AS*}$. (ii) Under the reselling mode, for all $0 \leq \delta < 1$, $\pi_S^{RC*} > \pi_S^{RS*}$, $\pi_{LSE}^{RC*} > \pi_{LSE}^{RS*}$.

Theorem 3 demonstrates that CP consumers generate higher economic value than SP consumers for both the supplier and the LSE under either selling mode. This result remains valid across all feasible regions of the LSE's selling ability because it originates from the different demand-generation mechanisms of the two consumer segments rather than the specific profit-allocation structure. SP consumers mainly value product-related information and purchasing convenience. Their additional utility from live streaming is stronger among consumers with higher product valuations, which supports a higher retail price but limits market expansion. In contrast, CP consumers obtain utility from entertainment, interaction, and content engagement, enabling the LSE to attract more consumers through exposure. Although targeting CP consumers reduces the equilibrium price, the resulting increase in traffic demand and sales volume dominates the price reduction effect, leading to higher profits for both supply chain members.

Proposition 2. Consumer-preference strategy under different selling modes. (i) Under the agency mode, the supplier and the LSE consistently prefer collaborating with an LSE targeting CP consumers rather than SP consumers. (ii) Under the reselling mode, the supplier and the LSE consistently prefer collaborating with an LSE targeting CP consumers rather than SP consumers.

The results of Proposition 2 indicate that consumer-targeting strategies differ fundamentally from selling-mode choices. While selling-mode decisions depend on the trade-off between revenue allocation and incentive coordination, consumer-targeting decisions are mainly determined by the demand-generation capability of live-streaming content. CP consumers place greater value on entertainment, interaction, and social engagement, allowing LSEs to convert consumer attention into additional purchases and expand market coverage. Therefore, the lower equilibrium retail price associated with CP consumers, the increase in traffic demand and sales volume, creates additional value for both the supplier and the LSE. This finding highlights that content-oriented consumers represent an important strategic market segment in live-streaming e-commerce, consistent with prior studies showing that live-streaming content enhances consumer engagement and retention (Gu *et al.*, 2025; Meng *et al.*, 2021).

Table 5. Summary of the main equilibrium results and managerial implications.

Consumer segment	Strategic outcome	Conditions	Main mechanism	Managerial implication
Proposition 1(i) (SP)	Reselling	$0 < \beta < \underline{\beta}_S$	A low commission weakens the LSE's traffic-acquisition incentive	Reselling is mutually preferred when revenue-sharing incentives are insufficient
Proposition 1(i) (SP)	Agency	$\beta_L^S < \beta < \bar{\beta}_S$	An intermediate commission balances traffic incentives and revenue sharing	Agency can align supplier-LSE preferences within an intermediate commission range
Proposition 1(ii) (CP)	Reselling	$0 \leq \delta < 1$, $0 < \beta < \underline{\beta}_C(\delta)$	A low commission makes agency selling unattractive to the LSE	Reselling is mutually preferred below the selling-ability-dependent threshold
Proposition 1(ii) (CP)	Agency	$0 \leq \delta < \frac{5}{8}$, $\beta_L^C(\delta) < \beta < \bar{\beta}_C(\delta)$	Content value increases the return from traffic acquisition	Agency alignment depends jointly on commission and LSE selling ability
Proposition 2 (SP versus CP)	Targeting CP consumers	Applicable baseline parameter ranges	CP consumers derive additional value from livestream content	Suppliers and LSEs can prioritize content-oriented segments when content value can be effectively monetized

The extension analysis further shows that introducing consumer viewing costs changes the threshold conditions quantitatively but does not overturn the main qualitative findings regarding selling-mode choice and consumer-targeting strategies.

6. EXTENSION

In the basic model, consumers are assumed to participate in live-streaming shopping without additional participation costs. However, in practice, consumers need to devote time and attention resources to viewing live-streaming, which may affect their willingness to engage in live-streaming shopping. Following Pan *et al.* (2022) and Huang *et al.* (2024), we extend the model by assuming that consumers incur a viewing cost c_l when participating in live-streaming shopping. This extension captures the opportunity cost of consumer attention and examines whether the main strategic implications of the baseline model remain valid when consumer participation frictions are considered.

Proposition 3. Robustness of selling-mode preference alignment under consumer viewing costs. (i) For SP consumers, introducing consumer viewing costs does not change the preference alignment between the supplier and the LSE. Both parties continue to prefer the reselling mode when $0 < \beta < \underline{\beta}_S$, whereas they jointly prefer the agency mode when $\beta_L^S < \beta < \bar{\beta}_S$. (ii) For CP consumers, consumer viewing costs only shift the preference boundaries but do not change the qualitative pattern of selling-mode alignment. Both parties prefer the reselling mode when $0 \leq \delta < 1$ and $0 < \beta < \hat{\beta}_C(\delta, c_l)$, whereas they prefer the agency mode when $0 \leq \delta < \frac{5+3c_l}{8}$ and $\hat{\beta}_L^C(\delta, c_l) < \beta < \bar{\beta}_C(\delta, c_l)$.

$$\text{where } \hat{\beta}_L^C(\delta, c_l) = \begin{cases} \frac{9}{16}, & 0 \leq \delta < \frac{1+c_l}{2}, \\ \frac{9(1-c_l)^2}{64(\delta-c_l)(1-\delta)}, & \frac{1+c_l}{2} \leq \delta < \frac{5+3c_l}{8}, \\ \frac{1-\delta}{\delta-c_l}, & \frac{5+3c_l}{8} \leq \delta < \frac{2+c_l}{3}, \\ \frac{1}{2}, & \frac{2+c_l}{3} \leq \delta < 1. \end{cases}, \quad \bar{\beta}_C(\delta, c_l) = \begin{cases} \frac{8-\sqrt{10}}{16}, & 0 \leq \delta < \frac{1+c_l}{2}, \\ \frac{1}{2} \left[1 - \sqrt{1 - \frac{27(1-c_l)^4}{512(\delta-c_l)^2(1-\delta)^2}} \right], & \frac{1+c_l}{2} \leq \delta < \frac{5+3c_l}{8}, \\ \frac{2\delta-c_l-1}{\delta-c_l}, & \frac{5+3c_l}{8} \leq \delta < \frac{2+c_l}{3}, \\ \frac{1}{2}, & \frac{2+c_l}{3} \leq \delta < 1. \end{cases}, \quad \text{and } \hat{\beta}_C(\delta, c_l) = \begin{cases} \frac{8+\sqrt{10}}{16}, & 0 \leq \delta < \frac{1+c_l}{2}, \\ \frac{1}{2} \left[1 + \sqrt{1 - \frac{27(1-c_l)^4}{512(\delta-c_l)^2(1-\delta)^2}} \right], & \frac{1+c_l}{2} \leq \delta < \frac{5+3c_l}{8}, \\ \frac{1-\delta}{\delta-c_l}, & \frac{5+3c_l}{8} \leq \delta < \frac{2+c_l}{3}, \\ \frac{1}{2}, & \frac{2+c_l}{3} \leq \delta < 1. \end{cases}$$

The results of Proposition 3 are illustrated in Figure 6. The shaded areas indicate the parameter regions in which the corresponding equilibrium preference conditions hold. The comparison between different values of c_l shows that consumer viewing costs affect the locations of the threshold boundaries rather than the fundamental structure of selling-mode preferences. For SP consumers, the viewing-cost term affects the profits under both selling modes proportionally and therefore cancels out in the preference comparison. Consequently, all selling-mode preference thresholds remain unchanged.

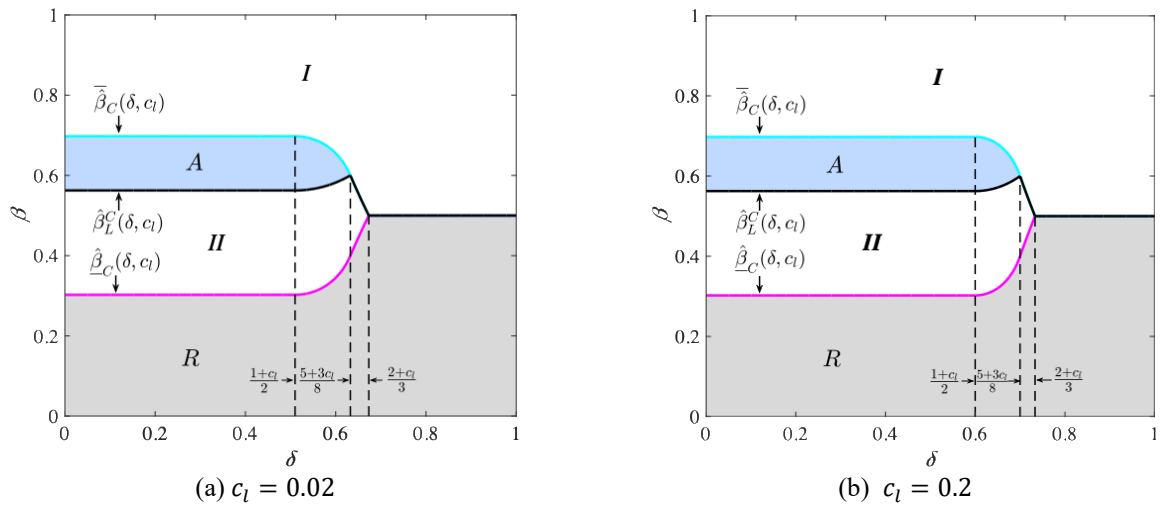


Figure 6. Robustness of selling-mode preference alignment under different consumer viewing costs.

For CP consumers, increasing c_l shifts the thresholds $\frac{1+c_l}{2}$, $\frac{5+3c_l}{8}$, and $\frac{2+c_l}{3}$ upward. A higher viewing cost reduces consumers' willingness to participate in live-streaming shopping, making demand generation more sensitive to the

efficiency of the selling mode. As a result, the agency mode, which avoids double marginalization and better coordinates sales incentives, becomes relatively more attractive over a wider parameter region.

Comparing Proposition 3 with Proposition 1 confirms the robustness of the baseline findings. When $c_l = 0$, the extended model converges to the baseline model. Therefore, consumer viewing costs modify the quantitative thresholds but do not overturn the qualitative preference-alignment pattern between the supplier and the LSE.

Proposition 4. Robustness of consumer-targeting strategies under consumer viewing costs.

- (i) Under the agency mode, incorporating consumer viewing costs does not change the optimal consumer-targeting strategy. Both the supplier and the LSE continue to prefer targeting CP consumers rather than SP consumers.
- (ii) Under the reselling mode, incorporating consumer viewing costs also preserves the optimal consumer-targeting strategy. Both the supplier and the LSE continue to prefer targeting CP consumers rather than SP consumers.

Proposition 4 confirms the robustness of the consumer-targeting strategy obtained in the baseline model. Although consumer viewing costs reduce consumers' net utility and decrease the overall attractiveness of live-streaming participation, they do not change the relative advantage of CP consumers. The reason is that CP consumers obtain greater utility from live-streaming content, allowing LSEs to generate stronger traffic conversion effects compared with SP consumers.

Comparing Proposition 4 with Proposition 2 further demonstrates the robustness of the baseline consumer-targeting result. When $c_l = 0$, the extended model degenerates into the baseline model, and the same consumer-targeting preference is obtained. Therefore, consumer participation costs influence profitability levels but do not alter the relative attractiveness of CP consumers.

7. CONCLUSIONS

In recent years, live-streaming e-commerce has become an increasingly important retail channel that reshapes consumer engagement and supply chain relationships. Existing studies have examined consumer preferences (Hardesty *et al.*, 2025), motivations for viewing live-streaming (Wu *et al.*, 2024; Liu *et al.*, 2023), and selling-mode choices in supply chains (Li *et al.*, 2025a; Huang *et al.*, 2025). However, limited attention has been devoted to how heterogeneous consumer preferences, LSE selling ability, and platform traffic pricing jointly influence selling-mode decisions and the alignment of strategic preferences between suppliers and LSEs.

This study develops a game-theoretic live-streaming e-commerce supply chain model involving a platform, a supplier, an LSE, and two consumer segments: SP and CP consumers. We investigate how consumer heterogeneity and traffic pricing influence selling-mode choices, consumer-targeting strategies, and supplier–LSE preference alignment. An extension incorporating consumer viewing costs further examines the robustness of the main findings.

7.1. Main findings

First, our results show that heterogeneous consumer preferences significantly affect selling-mode choice. The agency and reselling modes exhibit different advantages depending on the commission structure and incentive alignment. The reselling mode is preferred when the commission rate is relatively low because the LSE lacks sufficient incentives to invest in traffic under the agency mode. In contrast, the agency mode becomes mutually preferred within an intermediate commission-rate range because it provides effective traffic incentives while mitigating the double-marginalization problem. These findings highlight that selling-mode decisions should be jointly determined by revenue allocation mechanisms and consumer demand characteristics.

Second, we find that LSE selling ability is an important source of value creation in live-streaming e-commerce. A higher selling ability improves consumers' perceived value from live-streaming interactions, enhances traffic conversion, and increases the return on traffic investment. Moreover, CP consumers generate stronger demand expansion effects because they obtain additional value from live-streaming content. Consequently, both the supplier and the LSE consistently prefer to target CP consumers across different selling modes.

Third, platform traffic pricing plays a critical role in shaping traffic acquisition incentives and the strategic interaction between the supplier and the LSE. The platform's optimal traffic price reflects a trade-off between traffic revenue and the LSE's willingness to purchase traffic. Therefore, traffic pricing decisions affect not only platform profitability but also whether the supplier and the LSE can achieve aligned selling-mode preferences.

Finally, the extension analysis shows that incorporating consumer viewing costs changes equilibrium outcomes quantitatively but does not overturn the main qualitative conclusions. Specifically, viewing costs shift the threshold boundaries of selling-mode preference regions while preserving the fundamental preference-alignment pattern and consumer-targeting strategy.

7.2. Managerial implications

The findings provide several managerial implications for live-streaming e-commerce participants.

First, suppliers should carefully select selling modes based on consumer characteristics and commission rates. The agency mode is more attractive when commission incentives can effectively stimulate LSE traffic investment, whereas the reselling mode may be preferable when revenue-sharing incentives are insufficient or when suppliers value a stable wholesale margin.

Second, LSEs should strengthen their selling capabilities and content operations because CP consumers generate greater value from live-streaming interactions. Enhancing content quality, interaction capability, and consumer engagement can improve consumers' purchase responses and increase the sales value generated by purchased traffic.

Third, platforms should design traffic pricing strategies carefully. Appropriate traffic pricing can balance traffic monetization and LSE participation incentives, thereby improving traffic utilization and supply chain performance. Excessive traffic prices may reduce LSE willingness to acquire traffic and weaken overall channel efficiency.

From a practical perspective, the key model parameters can be linked to observable operational indicators. The unit traffic price corresponds to the price charged by the platform for paid exposure or algorithmic promotion, while traffic acquisition can be observed from purchased impressions, promoted views, clicks, or unique visitors. Traffic-reach efficiency can be estimated using the incremental effective views or product-page visits generated per unit of purchased traffic. LSE selling ability can be approximated using historical viewer-to-buyer conversion rates, sales per thousand views, or the incremental conversion uplift attributable to the LSE. These indicators provide practical proxies for applying the threshold-based decision framework.

7.3. Limitations and future research

This study has several limitations that provide opportunities for future research.

First, we consider a single supplier, platform, and LSE framework to derive analytical insights. Although this approach enables tractable analysis of strategic interactions, future studies could incorporate multiple suppliers, competing platforms, or multiple LSEs to examine competitive dynamics and partner selection in live-streaming e-commerce ecosystems.

Second, we characterize consumer heterogeneity using two representative consumer groups: shopping-preferred and content-preferred consumers. Future research could consider richer consumer heterogeneity, including price sensitivity, impulse purchasing behavior, brand loyalty, and preferences for different types of live-streaming content.

Third, we use the square root reach function $G(t) = r\sqrt{t}$ to capture diminishing marginal returns to traffic acquisition. Although this parsimonious specification is more realistic than a linear conversion function and preserves analytical tractability, actual traffic effectiveness may depend on traffic quality, recommendation algorithms, targeting accuracy, repeated exposure, and platform-specific conversion mechanisms. Future research could examine alternative concave reach functions and calibrate the traffic-response relationship using platform-level impression, click, viewing records, and sales-conversion data.

Finally, the analytical model relies on theoretical assumptions and does not calibrate parameters using large-scale empirical data. Future research could combine empirical observations or platform-level data to validate the proposed relationships and quantify the practical impact of key parameters.

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APPENDIX A. Proofs of Lemmas, Theorems, Corollaries, and Propositions

Proof of Lemma 1.

In scenario AS, given p_t and p_l , the LSE chooses t to maximize $\pi_{LSE}^{AS} = \beta r p_l \left(1 - \frac{p_l}{1+\delta}\right) \sqrt{t} - p_t t$. For $0 < p_l < 1 + \delta$, the second-order derivative with respect to t is $\frac{\partial^2 \pi_{LSE}^{AS}}{\partial t^2} = -\frac{\beta r p_l \left(1 - \frac{p_l}{1+\delta}\right)}{4t^{3/2}} < 0$. Thus, the LSE's optimal traffic acquisition is $t^{AS}(p_l, p_t) = \frac{r^2 \beta^2 p_l^2 \left(1 - \frac{p_l}{1+\delta}\right)^2}{4p_t^2}$. Anticipating this response, the supplier's profit can be written as $\pi_S^{AS} = \frac{\beta(1-\beta)r^2}{2p_t} \left[p_l \left(1 - \frac{p_l}{1+\delta}\right)\right]^2$. Therefore, maximizing π_S^{AS} is equivalent to maximizing $p_l \left(1 - \frac{p_l}{1+\delta}\right)$, whose unique maximizer is $p_l^{AS*} = \frac{1+\delta}{2}$. Substituting p_l^{AS*} into $t^{AS}(p_l, p_t)$ gives $t^{AS}(p_t) = \frac{r^2 \beta^2 (1+\delta)^2}{64p_t^2}$. The platform then maximizes $\pi_P^{AS} = (p_t - c_t)t^{AS}(p_t) - c_0$. Differentiating with respect to p_t gives $\frac{\partial \pi_P^{AS}}{\partial p_t} = \frac{r^2 \beta^2 (1+\delta)^2 (2c_t - p_t)}{64p_t^3}$. Hence, platform profit increases for $p_t < 2c_t$ and decreases for $p_t > 2c_t$, yielding $p_t^{AS*} = 2c_t$. Substituting p_t^{AS*} into $t^{AS}(p_t)$ gives $t^{AS*} = \frac{r^2 \beta^2 (1+\delta)^2}{256c_t^2}$. Therefore, the equilibrium outcomes stated in Lemma 1 are obtained.

Proof of Lemma 2.

In scenario AC, given p_t and p_l , the LSE chooses t to maximize $\pi_{LSE}^{AC} = \beta r p_l q^C(p_l) \sqrt{t} - p_t t$, where $q^C(p_l) = \begin{cases} 1, & 0 \leq p_l \leq \delta, \\ \frac{1-p_l}{1-\delta}, & \delta < p_l < 1. \end{cases}$. Because $\frac{\partial^2 \pi_{LSE}^{AC}}{\partial t^2} = -\frac{\beta r p_l q^C(p_l)}{4t^{3/2}} < 0$ whenever $q^C(p_l) > 0$, the LSE's optimal traffic acquisition is $t^{AC}(p_l, p_t) = \frac{r^2 \beta^2 [p_l q^C(p_l)]^2}{4p_t^2}$. After substituting the LSE's response, the supplier's profit is proportional to $[p_l q^C(p_l)]^2$. In the partial-purchase region, $p_l q^C(p_l) = \frac{p_l(1-p_l)}{1-\delta}$, whose unconstrained maximizer is $p_l = \frac{1}{2}$. This solution is feasible when $0 \leq \delta < \frac{1}{2}$. When $\frac{1}{2} \leq \delta < 1$, the maximum occurs at the full-purchase boundary $p_l = \delta$. Therefore, $p_l^{AC*} = \begin{cases} \frac{1}{2}, & 0 \leq \delta < \frac{1}{2}, \\ \delta, & \frac{1}{2} \leq \delta < 1. \end{cases}$ Substituting p_l^{AC*} into $t^{AC}(p_l, p_t)$ gives $t^{AC} = \begin{cases} \frac{r^2 \beta^2}{64p_t^2(1-\delta)^2}, & 0 \leq \delta < \frac{1}{2}, \\ \frac{r^2 \beta^2 \delta^2}{4p_t^2}, & \frac{1}{2} \leq \delta < 1. \end{cases}$ In either region, write $t^{AC}(p_t) = \frac{K^{AC}}{p_t^2}$, where $K^{AC} > 0$. The platform's profit is $\pi_P^{AC} = \frac{K^{AC}(p_t - c_t)}{p_t^2} - c_0$, and its derivative is $\frac{\partial \pi_P^{AC}}{\partial p_t} = \frac{K^{AC}(2c_t - p_t)}{p_t^3}$. Hence, $p_t^{AC*} = 2c_t$. Substituting p_t^{AC*} into $t^{AC}(p_t)$ yields $t^{AC*} = \begin{cases} \frac{r^2 \beta^2}{256c_t^2(1-\delta)^2}, & 0 \leq \delta < \frac{1}{2}, \\ \frac{r^2 \beta^2 \delta^2}{16c_t^2}, & \frac{1}{2} \leq \delta < 1. \end{cases}$ Therefore, the equilibrium outcomes stated in Lemma 2 are obtained.

Proof of Lemma 3.

In scenario RS. Under the reselling mode with SP consumers, the LSE determines p_l and t after observing p_t and w . The LSE solves $\max_{p_l, t} \pi_{LSE}^{RS} = (p_l - w)D^{RS} - p_t t$, where $D^{RS} = r\sqrt{t} \left(1 - \frac{p_l}{1+\delta}\right)$. The first- and second-order derivatives with respect to p_l and t are: $\frac{\partial^2 \pi_{LSE}^{RS}}{\partial p_l^2} = -\frac{2r\sqrt{t}}{1+\delta} < 0$, $\frac{\partial^2 \pi_{LSE}^{RS}}{\partial t^2} = -\frac{r(p_l - w)(1+\delta - p_l)}{2(1+\delta)t^{3/2}}$, and $\frac{\partial^2 \pi_{LSE}^{RS}}{\partial p_l \partial t} = \frac{r(1+\delta + w - 2p_l)}{2(1+\delta)\sqrt{t}}$. Therefore, the Hessian matrix is $H = \begin{bmatrix} -\frac{2r\sqrt{t}}{1+\delta} & \frac{r(1+\delta + w - 2p_l)}{2(1+\delta)\sqrt{t}} \\ \frac{r(1+\delta + w - 2p_l)}{2(1+\delta)\sqrt{t}} & -\frac{r(p_l - w)(1+\delta - p_l)}{2(1+\delta)t^{3/2}} \end{bmatrix}$. Under the economically feasible region $w < p_l < 1 + \delta$, we have $\frac{\partial^2 \pi_{LSE}^{RS}}{\partial p_l^2} < 0$. Moreover, the determinant of the Hessian matrix is $|H| = \frac{r^2(p_l - w)}{(1+\delta)^2 t} > 0$. Hence, the Hessian matrix is negative definite, and the LSE's profit function is jointly concave in (p_l, t) . Solving the first-order conditions gives $p_l = \frac{1+\delta+w}{2}$, and $t = \frac{r^2(1+\delta-w)^4}{64(1+\delta)^2 p_t^2}$. Substituting the LSE's optimal decisions into the supplier's profit function $\pi_S^{RS} = wD^{RS}$, the supplier's objective function is concave in w , and the optimal wholesale price is $w^{RS*} = \frac{1+\delta}{4}$. Finally, substituting the above results into the platform's profit function, $\pi_P^{RS} = p_t t - (c_0 + c_t t)$, the platform's objective function is concave in p_t . The first-order condition yields $p_t^{RS*} = 2c_t$. Substituting p_t^{RS*} into the equilibrium

decisions gives $p_l^{RS*} = \frac{5(1+\delta)}{8}$, and $t^{RS*} = \frac{81r^2(1+\delta)^2}{65536c_t^2}$. Therefore, the equilibrium outcomes stated in Lemma 3 are obtained.

Proof of Lemma 4.

In scenario RC. Under the reselling mode with CP consumers, the LSE determines p_l and t after observing p_t and w . The LSE solves the following joint optimization problem: $\max_{p_l, t} \pi_{LSE}^{RC} = (p_l - w)D^{RC} - p_t t$. Because the purchase probability of CP consumers is piecewise defined as $q^C(p_l) = \begin{cases} 1, & 0 \leq p_l \leq \delta, \\ \frac{1-p_l}{1-\delta}, & \delta < p_l < 1. \end{cases}$ The optimization problem is solved separately in different regions. Region 1: $0 \leq \delta < \frac{5}{8}$. For $\delta < p_l < 1$, the demand function is $D^{RC} = r\sqrt{t} \frac{1-p_l}{1-\delta}$. The Hessian matrix of the LSE profit function is $H = \begin{bmatrix} -\frac{2r\sqrt{t}}{1-\delta} & \frac{r(1+w-2p_l)}{2(1-\delta)\sqrt{t}} \\ \frac{r(1+w-2p_l)}{2(1-\delta)\sqrt{t}} & -\frac{r(p_l-w)(1-p_l)}{2(1-\delta)t^{3/2}} \end{bmatrix}$. Since $w < p_l < 1$, we have $\frac{\partial^2 \pi_{LSE}^{RC}}{\partial p_l^2} < 0$, and $|H| = \frac{r^2(p_l-w)}{(1-\delta)^2 t} > 0$. Therefore, the LSE's profit function is jointly concave in (p_l, t) . Solving the first-order conditions and substituting the LSE's response into the supplier's problem gives $w^{RC*} = \frac{1}{4}$, $p_l^{RC*} = \frac{5}{8}$, and $t^{RC*} = \frac{81r^2}{65536c_t^2(1-\delta)^2}$. Region 2: $\frac{5}{8} \leq \delta < \frac{2}{3}$. In this region, the optimal solution reaches the boundary $p_l^{RC*} = \delta$. The concavity condition established in Region I guarantees the uniqueness of the optimal solution in the feasible region. The remaining regions correspond to boundary solutions, and substituting these boundary conditions into the supplier's problem yields $\frac{\partial^2 \pi_{LSE}^{RC}}{\partial p_l^2} < 0$, and $|H| > 0$. The supplier's optimization yields $w^{RC*} = 2\delta - 1$, and the corresponding traffic demand is $t^{RC*} = \frac{r^2(1-\delta)^2}{16c_t^2}$. Region 3: $\frac{2}{3} \leq \delta < 1$. Similarly, the optimal retail price remains at the boundary $p_l^{RC*} = \delta$. The supplier's optimization gives $w^{RC*} = \frac{\delta}{2}$, and the equilibrium traffic demand becomes $t^{RC*} = \frac{r^2\delta^2}{64c_t^2}$. Finally, substituting the equilibrium responses into the platform profit function $\pi_P^{RC} = p_t t - (c_0 + c_t t)$, we obtain $\frac{\partial^2 \pi_P^{RC}}{\partial p_t^2} < 0$. Therefore, the platform's problem is concave in p_t , and the first-order condition gives $p_t^{RC*} = 2c_t$. Combining the three feasible regions yields the equilibrium outcomes stated in Lemma 4.

Proof of Corollary 1.

(i) Using the equilibrium outcomes in Lemma 1 and Lemma 3, the difference in traffic prices between the agency and reselling modes is $p_t^{AS*} - p_t^{RS*} = 0$. Therefore, $p_t^{AS*} = p_t^{RS*}$. The difference in equilibrium retail prices is $p_l^{AS*} - p_l^{RS*} = \frac{1+\delta}{2} - \frac{5(1+\delta)}{8}$. Thus, $p_l^{AS*} - p_l^{RS*} = -\frac{1+\delta}{8} < 0$, which implies $p_l^{AS*} < p_l^{RS*}$. For traffic demand, using equilibrium outcomes, $t^{AS*} - t^{RS*} = \frac{r^2(1+\delta)^2}{65536c_t^2}(256\beta^2 - 81)$. Since $\frac{r^2(1+\delta)^2}{65536c_t^2} > 0$, the sign depends on $256\beta^2 - 81$. Solving $256\beta^2 - 81 = 0$ gives $\beta_L^S = \frac{9}{16}$. Therefore, if $\beta > \beta_L^S$, then $t^{AS*} > t^{RS*}$; otherwise, $t^{AS*} \leq t^{RS*}$.

(ii) Using the equilibrium results in Lemma 2 and Lemma 4, the difference in traffic prices between the agency and reselling modes is $p_t^{AC*} - p_t^{RC*} = 0$. Therefore, $p_t^{AC*} = p_t^{RC*}$. Next, comparing retail prices: For $0 \leq \delta < \frac{5}{8}$, we have $p_l^{AC*} > p_l^{RC*}$. When $\frac{5}{8} \leq \delta < \frac{2}{3}$, both modes satisfy $p_l^{AC*} = p_l^{RC*} = \delta$. Hence, $p_l^{AC*} \leq p_l^{RC*}$. Finally, comparing traffic demands, we define $\Delta t^C = t^{AC*} - t^{RC*}$. Substituting the equilibrium traffic demands from Lemma 2 and Lemma 4 gives $\Delta t^C = t^{AC*} - t^{RC*}$. Substituting the corresponding piecewise equilibrium traffic demands from Lemma 2 and Lemma 4 gives the threshold $\beta_L^C(\delta)$. The sign of Δt^C depends on the commission rate β . Solving $t^{AC*} = t^{RC*}$ yields the threshold $\beta_L^C(\delta)$. Therefore, if $\beta > \beta_L^C(\delta)$, then $t^{AC*} > t^{RC*}$; otherwise, $t^{AC*} \leq t^{RC*}$. Therefore, Corollary 1 follows.

Proof of Theorem 1.

For SP consumers, we compare the equilibrium profits of the supplier and the LSE under the agency and reselling modes.

First, the supplier's profit difference is defined as $\Delta \pi_S^S = \pi_S^{AS*} - \pi_S^{RS*}$. Using the equilibrium profits obtained in Lemma 1 and Lemma 3, we have $\pi_S^{AS*} = \frac{r^2\beta(1-\beta)(1+\delta)^2}{64c_t}$, and $\pi_S^{RS*} = \frac{27r^2(1+\delta)^2}{8192c_t}$. Therefore, $\Delta \pi_S^S = \frac{r^2(1+\delta)^2}{8192c_t}[128\beta(1-\beta) - 27]$. Since $\frac{r^2(1+\delta)^2}{8192c_t} > 0$, the sign of the supplier profit difference depends only on $128\beta(1-\beta) - 27$. Solving

$128\beta(1-\beta) - 27 = 0$ gives two critical values: $\underline{\beta}_S = \frac{8-\sqrt{10}}{16}$, and $\bar{\beta}_S = \frac{8+\sqrt{10}}{16}$. Therefore, if $\underline{\beta}_S < \beta < \bar{\beta}_S$, then $\Delta\pi_S^S > 0$, which implies that the supplier prefers the agency mode. Otherwise, $\pi_S^{AS*} \leq \pi_S^{RS*}$, and the supplier prefers the reselling mode.

Next, we compare the LSE's equilibrium profits. Define $\Delta\pi_{LSE}^S = \pi_{LSE}^{AS*} - \pi_{LSE}^{RS*}$. Substituting the equilibrium profits gives $\Delta\pi_{LSE}^S = \frac{r^2(1+\delta)^2}{32768c_t} [256\beta^2 - 81]$. Because the denominator is positive, the sign depends on $256\beta^2 - 81$. Solving $256\beta^2 - 81 = 0$ yields $\beta_L^S = \frac{9}{16}$. Therefore, if $\beta > \beta_L^S$, then $\Delta\pi_{LSE}^S > 0$, indicating that the LSE prefers agency selling. Otherwise, $\pi_{LSE}^{AS*} \leq \pi_{LSE}^{RS*}$, and the LSE prefers reselling. Therefore, Theorem 1 follows.

Proof of Theorem 2.

For CP consumers, the purchase probability is piecewise defined as $q^C(p_l) = \begin{cases} 1, & 0 \leq p_l \leq \delta, \\ \frac{1-p_l}{1-\delta}, & \delta < p_l < 1. \end{cases}$ Consequently, the equilibrium outcomes and the firms' selling-mode preferences must be examined over the combined parameter regions identified in Lemmas 2 and 4.

First, define the supplier's profit difference between agency and reselling as $\Delta\pi_S^C = \pi_S^{AC*} - \pi_S^{RC*}$.

Region 1: $0 \leq \delta < \frac{1}{2}$. In this region, $\pi_S^{AC*} = \frac{r^2\beta(1-\beta)}{64c_t(1-\delta)^2}$, and $\pi_S^{RC*} = \frac{27r^2}{8192c_t(1-\delta)^2}$. Thus, $\Delta\pi_S^C = \frac{r^2}{8192c_t(1-\delta)^2} [128\beta(1-\beta) - 27]$. Solving $\Delta\pi_S^C = 0$ gives $\underline{\beta}_C = \frac{8-\sqrt{10}}{16}$, and $\bar{\beta}_C = \frac{8+\sqrt{10}}{16}$. Because $\Delta\pi_S^C$ is positive between the two roots, the supplier prefers agency selling if $\underline{\beta}_C < \beta < \bar{\beta}_C$.

Region 2: $\frac{1}{2} \leq \delta < \frac{5}{8}$. In this region, $\pi_S^{AC*} = \frac{r^2\beta(1-\beta)\delta^2}{4c_t}$, and $\pi_S^{RC*} = \frac{27r^2}{8192c_t(1-\delta)^2}$. Therefore, $\Delta\pi_S^C = \frac{r^2}{4c_t} [\beta(1-\beta)\delta^2 - \frac{27}{2048(1-\delta)^2}]$. Solving $\Delta\pi_S^C = 0$ gives $\underline{\beta}_C(\delta) = \frac{1}{2} \left[1 - \sqrt{1 - \frac{27}{512\delta^2(1-\delta)^2}} \right]$, and $\bar{\beta}_C(\delta) = \frac{1}{2} \left[1 + \sqrt{1 - \frac{27}{512\delta^2(1-\delta)^2}} \right]$. Because $\Delta\pi_S^C$ is positive between the two roots, the supplier prefers agency selling if $\underline{\beta}_C(\delta) < \beta < \bar{\beta}_C(\delta)$.

Region 3: $\frac{5}{8} \leq \delta < \frac{2}{3}$. In this region, $\pi_S^{AC*} = \frac{r^2\beta(1-\beta)\delta^2}{4c_t}$, and $\pi_S^{RC*} = \frac{r^2(2\delta-1)(1-\delta)}{4c_t}$. Therefore, $\Delta\pi_S^C = \frac{r^2}{4c_t} [\beta(1-\beta)\delta^2 - (2\delta-1)(1-\delta)]$. Solving $\Delta\pi_S^C = 0$ gives $\underline{\beta}_C(\delta) = 2 - \frac{1}{\delta}$, and $\bar{\beta}_C(\delta) = \frac{1-\delta}{\delta}$. Because $\Delta\pi_S^C$ is positive between the two roots, the supplier prefers agency selling if $\underline{\beta}_C(\delta) < \beta < \bar{\beta}_C(\delta)$.

Region 4: $\frac{2}{3} \leq \delta < 1$. In this region, $\pi_S^{AC*} = \frac{r^2\beta(1-\beta)\delta^2}{4c_t}$, and $\pi_S^{RC*} = \frac{r^2\delta^2}{16c_t}$. Therefore, $\Delta\pi_S^C = \frac{r^2\delta^2}{4c_t} [\beta(1-\beta) - \frac{1}{4}]$. Because $(1-\beta)\beta \leq \frac{1}{4}$, with equality if and only if $\frac{1}{2}$, it follows that $\Delta\pi_S^C \leq 0$. Therefore, for $\frac{2}{3} \leq \delta < 1$, the supplier weakly prefers reselling. The supplier is indifferent between agency and reselling only when $\beta = \frac{1}{2}$. Hence, the agency-preference interval collapses to the singleton $\frac{1}{2}$, which represents an indifference point rather than a strict agency-preference region.

Similarly, define $\Delta\pi_{LSE}^C = \pi_{LSE}^{AC*} - \pi_{LSE}^{RC*}$. Substituting equilibrium profits and solving $\Delta\pi_{LSE}^C = 0$ yields the threshold $\beta_L^C(\delta)$. Specifically, $\beta_L^C(\delta) = \begin{cases} \frac{9}{16}, & 0 \leq \delta < \frac{1}{2}, \\ \frac{9}{64\delta(1-\delta)}, & \frac{1}{2} \leq \delta < \frac{5}{8}, \\ \frac{1-\delta}{\delta}, & \frac{5}{8} \leq \delta < \frac{2}{3}, \\ \frac{1}{2}, & \frac{2}{3} \leq \delta < 1. \end{cases}$ Therefore, if $\beta > \beta_L^C(\delta)$, then $\Delta\pi_{LSE}^C > 0$, which means that

the LSE prefers agency selling.

Proof of Corollary 2.

The proof of Corollary 2 follows directly from the equilibrium outcomes in Lemmas 1–4. Therefore, the detailed derivations are omitted for brevity.

Proof of Theorem 3 and Proposition 2.

The proof of Theorem 3 follows the same logic as that of Theorem 1 and Theorem 2. The omitted derivations involve only straightforward substitutions of equilibrium profits. Proposition 2 directly follows from Theorem 3 by comparing the preferences of the supplier and the LSE. Therefore, the detailed proofs are omitted.

Proof of Proposition 3.

Comparing the supplier's and the LSE's equilibrium profits under the agency and reselling modes yields the corresponding profit differences. For SP consumers, $\Delta\pi_S^S(c_l) = \pi_S^{AS*} - \pi_S^{RS*}$, $\Delta\pi_{LSE}^S(c_l) = \pi_{LSE}^{AS*} - \pi_{LSE}^{RS*}$. Setting the profit differences equal to zero gives the threshold values $\underline{\beta}_S$, $\bar{\beta}_S$, β_L^S . Similarly, for CP consumers, $\Delta\pi_S^C = \pi_S^{AC*} - \pi_S^{RC*}$, $\Delta\pi_{LSE}^C = \pi_{LSE}^{AC*} - \pi_{LSE}^{RC*}$, whose roots determine $\hat{\beta}_L^C(\delta, c_l)$, $\hat{\beta}_C(\delta, c_l)$, and $\bar{\beta}_C(\delta, c_l)$. By analyzing the signs of the above profit differences over different feasible regions of (δ, c_l) , Proposition 3 immediately follows.

Proof of Proposition 4.

Comparing the equilibrium profits obtained under SP and CP consumers gives $\pi_S^{AC*} - \pi_S^{AS*} > 0$, $\pi_{LSE}^{AC*} - \pi_{LSE}^{AS*} > 0$, and $\pi_S^{RC*} - \pi_S^{RS*} > 0$, $\pi_{LSE}^{RC*} - \pi_{LSE}^{RS*} > 0$. Hence, both the supplier and the LSE continue to prefer targeting CP consumers under both selling modes. Because the profit ranking between SP and CP consumers remains unchanged after incorporating viewing costs, the qualitative conclusions of Proposition 2 remain valid. Thus, Proposition 4 follows.